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(54) **Mobile telecommunications system with improved management of its radio resources**

Mobilfunksystem mit verbesserter Verwaltung seiner Radiobetriebsmittel

Système de télécommunication mobile avec une gestion améliorée de ses ressources radio

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**WO-A-02/01907** **WO-A-99/52317**  
**US-A- 6 081 723**

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## Description

**[0001]** The present invention relates to a UMTS (Universal Mobile Telephone System) type mobile radio telecommunications system with improved management of its radio resources.

**[0002]** International (PCT) patent publications WO99/52317 and WO02/01907 are background to the present invention. WO02/01907 was published on 3<sup>rd</sup> January 2002 which is after the filing date of the present patent/patent application.

**[0003]** It is known from WO02/01907 to provide mobile radio telecommunications system comprising a core network operative to communicate by means of a UTRAN network with a plurality of user equipments, said core network comprising a mobile switching centre and at least one serving GPRS support node, each user equipment being able to work selectively in two operating modes, firstly a connected mode in which the resources of the system are allocated to setting up a connection between the user equipment and said mobile switching centre and/or at least one serving GPRS support node, and secondly an idle mode, in which an interface (Gs) is provided by which in use said mobile switching centre and said at least one serving GPRS support node communicate said interface being designed to give said at least one serving GPRS support node the identity of the user equipments in connected mode with said mobile switching centre, said interface (Gs) being furthermore designed to give said at least one serving GPRS support node the identity of serving radio network controllers with which said mobile switching centre is linked to communicate with said user equipments in connected mode, and in that, to page one of the user equipments in connected mode with said mobile switching centre, said at least one serving GPRS support node is operative in use to directly communicate with the serving radio network controller concerned without going through said mobile switching centre characterised in that said mobile switching centre (10) periodically sends to the serving GPRS support node (11) the identities of the user equipments in connected mode.

**[0004]** In its classic form, a UMTS type telecommunications system consists of a core network, a Universal Terrestrial Radio Access Network (UTRAN) and mobile terminals commonly called user equipment (UEs). A system of this kind is shown in Figure 1. The core network comprises a mobile switching centre (MSC) referenced 10, linked to the public switched telephone network for the circuit switching service and a serving GPRS support node (SGSN) referenced 11, linked to the Internet for the packet switching service. The MSC 10 communicates with the SGSN 11 through an interface Gs. The UTRAN consists of a plurality of radio network controllers (RNCs) referenced 20 to 23, each controlling a set of logic elements called nodes B. Each RNC is connected to the MSC 10 and to the SGSN 11

of a core network by means of an interface Iu. The RNCs are also connected to one another by means of an interface Iur. Finally, each UE is connected to one or more nodes B through a radio interface, each node B serving a geographical zone called a cell.

**[0005]** In the example of Figure 1, the UTRAN has four RNCs 20, 21, 22 and 23 and each RNC controls two or three nodes B. An UE 30 is linked with one of the nodes B coming under the RNC 21.

**[0006]** The geographical zone that groups together the cells controlled by the RNCs coming under the MSC is called an LA or location area and the geographical zone that groups together the cells controlled by the RNCs coming under the SGSN is called an RA or routing area. In the example of Figure 1, these two zones are identical. However, it is not rare for several SGSNs to be associated with one and the same MSC. In this case, each SGSN has its own routing area and the location area covers all the routing areas of the SGSNs associated with the MSC.

**[0007]** The UEs have two operation modes: an idle mode and a connected mode. In the idle mode, no system resource is allocated specifically to the conveyance of data to and from the UE. The UE is in idle mode for example after it has been powered on. In this mode, whenever the UE changes its routing area or location area, an update operation is activated to update the location registers of the network.

**[0008]** The UE goes into connected mode when a connection is made to the system. Thus, as soon as the data has to be transmitted to a UE in idle mode, the core network uses the UTRAN network to send a paging message to the UE concerned, asking it to go into connected mode. The UE may also go into connected mode on its own initiative.

**[0009]** In connected mode, the UE can take four states known as mobility states, each corresponding to a given level of activity of the UE.

**[0010]** In the CELL\_DCH state, a dedicated channel (DCH) is assigned to the UE for the upward link and the downward link.

**[0011]** In the CELL\_FACH state, no dedicated physical channel is assigned to the UE. This UE constantly listens to a common channel FACH (or forward access channel) in the downward link of the cell considered. For the upward link, it can use a random-access channel (RACH). In both these states, the localization of the UE is known at the cell level. Whenever the UE changes its cell, it updates the network with its new cell location.

**[0012]** In the CELL\_PCH state, the UE monitors only the paging channel (PCH) of the cell considered. If it changes its cell, it goes into the CELL\_FACH state to update the network with its new cell location.

**[0013]** A fourth state in connected mode, called URA\_PCH, is also possible. A URA (UTRAN registration area) designates a geographical zone grouping cells that may be controlled as the case may be by different RNCs. The URA\_PCH (UTRAN registration area

paging channel) state is similar to the CELL\_PCH state apart from the fact that the network is updated only when the UE changes its URA. In this state, the localization of the UE is only known at the URA level.

**[0014]** These four mobility states as well as the transitions between them are described in greater detail in the technical specification "3GPP TS 25.331 V3.5.0" of the Radio Access Network Group, Section 7, pp. 30-32 and Appendix B, pp. 615-622, updated in September 2001.

**[0015]** When a connection between a UE and the core network is set up, it generally makes transit through the RNC controlling the cell in which the UE is located. When the UE moves, the connection is maintained through other cells that may be controlled by other RNCs. The connection makes transit through several RNCs between the UE and the core network. The serving RNC or SRNC then designates the RNC directly linked with the core network for a given connection between the UE and the core network. The SRNC generally corresponds to the RNC used when the connection is made. The drift RNCs or DRNCs designate the RNCs through which the call makes transit but which are not directly linked with the core network for this connection.

**[0016]** In such a system, a part of the radio resources is allocated to the paging channel (PCH). The paging channel is a transport channel of the downward link that is constantly transmitted by each node B to the entire cell. This channel is used by the UTRAN to contact a UE when it is in idle mode or in connected mode in the CELL\_PCH or URA\_PCH state.

**[0017]** The radio resources in a cell type system are not unlimited. They are used to provide an entire set of services, especially the paging service. If paging requirements of the system can be reduced, then it will be possible to reduce the size of the radio resources allocated to the paging channel and thus allocate more radio resources to the other services of the system (for example to convey voice or data).

**[0018]** An aim of the invention is to reduce the paging requirements of the system in order to reduce the size of the radio resources allocated to the paging channel in a UMTS system.

**[0019]** Indeed, the paging channel requirements of the presently used UMTS system are great. Let us take the example of a UE 30 communicating with the MSC 10 as shown in Figure 2. The UE 30 which is in a CELL\_DCH or CELL\_FACH state is connected with the MSC 10 through the SRNC 20 and the DRNC 21. This connection is represented by an arrow with dotted lines going from MSC 10 to the UE 30. The SGSN 11 then tries to transmit signalling information and/or data packets to the UE 30. The SGSN 11 therefore sends paging messages in the zone RA that is associated with it to contact the UE 30. It therefore transmits messages to the RNCs 20, 21, 22 and 23, asking them to send paging messages into the cells that they control.

**[0020]** At the UTRAN, the RNC 20 is the SRNC for

the connection in progress of the UE 30. As the case may be, the RNC 21, acting as a DRNC for the connection in progress, also knows the state of the UE 30. These two RNCs are the only ones to know that the UE 30 is already in connected mode with the MSC. The other RNCs perceive the UE 30 as being in idle mode. The result of this is that the RNCs 22, 23 unnecessarily send paging messages through the paging channels of the cells that they control.

**[0021]** If the UE 30 is in the URA\_PCH state, the situation is somewhat identical. All the RNCs controlling the cells of the RA zone send paging messages and therefore all the RNCs controlling cells outside the URA unnecessarily send paging messages, except for the SRNC which does not send paging messages if it is outside the URA.

**[0022]** Finally, if the UE 30 is in a CELL\_PCH state, all the RNCs controlling the cells of the RA zone, other than the SRNC and the DRNC controlling the cell in which the UE 30 is located if it is distinct from the SRNC, also unnecessarily send paging messages.

**[0023]** It is observed therefore that the radio resources allocated to the paging channel are unnecessarily encumbered in the present system. This arises chiefly out of lack of coordination between the different elements of the core network and of the UTRAN.

**[0024]** It is therefore an aim of the invention to eliminate any unnecessary sending of paging messages through the paging channel in order to release radio resources for the other services of the network.

**[0025]** An object of the invention is a mobile radio telecommunications system comprising a core network communicating by means of a UTRAN network with a plurality of user equipments, said core network comprising a mobile switching centre and at least one serving GPRS support node, each user equipment being able to work selectively in two operating modes, firstly a connected mode in which the resources of the system are allocated to setting up a connection between the user equipment and said mobile switching centre and/or at least one serving GPRS support node, and secondly an idle mode,

characterized in that said mobile switching centre and said at least one serving GPRS support node communicate by means of an interface, said interface being designed to give said at least one serving GPRS support node the identity of the user equipments in connected mode with said mobile switching centre, and in that, to page one of the user equipments in connected mode with said mobile switching centre, said at least one serving GPRS support node communicates with said user equipment through said mobile switching centre.

**[0026]** As an alternative embodiment, the interface between said mobile switching centre and said at least one serving GPRS support node gives said at least one serving GPRS support node not only the identity of the user equipments in connected mode with said mobile

switching centre but also the identity of the serving radio network controllers for the corresponding connections. Said at least one serving GPRS support node then directly transmits the paging messages to the serving radio network controllers without going through the mobile switching centre.

**[0027]** The characteristics and advantages of the invention shall appear more clearly from the following detailed description made with reference to the appended drawings, of which:

- Figure 1, already described, represents the architecture of a standard UMTS system;
- Figure 2 illustrates an example of the management of the radio resources allocated to the paging channel in a prior art system; and
- Figure 3 illustrates an example of the management of the radio resources allocated to the paging channel in a system according to the invention.

**[0028]** According to the invention, it is planned to modify the Gs interface between the MSC 10 and the SGSN 11 so that the SGSN 11 is regularly informed of the identity of the UEs in connected mode with the MSC 10.

**[0029]** The information on the identity of the UEs in connected mode is transmitted to the SGSN 11 either on the request of this SGSN 11 or on the initiative of the MSC 10. In the latter case, the information is for example sent periodically to the SGSN 11 or as soon as a UE goes into connected mode with the MSC 10.

**[0030]** When the SGSN 11 seeks to contact a UE, it verifies whether or not this UE is already in connected mode with the MSC 10. If this is not the case, it sends paging messages to all the cells of the associated RA. If it is the case, it sends a paging message to the MSC 10 which transmits it to the UE through its connection with its UE.

**[0031]** Thus, the MSC 10 will carry out maximum paging only for cells under the control of the SRNC 20 and/or the DRNC 21. If the UE is in a CELL\_DCH or CELL\_FACH state, the paging message is transmitted to the DCH or FACH channel with the data coming from the MSC 10. This case is illustrated in Figure 3 which has to be compared with Figure 2.

**[0032]** In this figure, the SGSN 11 seeks to contact the UE 30 in connected mode with the MSC 10 and, as in Figure 2, the UE 30 is in a CELL\_DCH or CELL\_FACH state.

**[0033]** According to the invention, the SGSN 11 knows that the UE 30 is in connected mode with the MSC 10. The SGSN 11 therefore sends a paging message to the MSC 10 which will retransmit this message to the UE 30 in the channel (DCH or FACH) used to transmit data to the UE 30. The unnecessary dispatch of paging messages through the cells controlled by the RNCs 21, 22 and 23 is avoided.

**[0034]** Similarly, if the UE 30 is in a URA\_PCH state,

the paging message coming from the MSC 10 will be broadcast only through the paging channel of the cells belonging to the URA. Finally, if the UE 30 is in a CELL\_PCH state, the paging message will be sent only through the paging channel of the concerned cell.

**[0035]** This system substantially limits the use of the paging channels of the radio resources.

**[0036]** As a variant, it can be planned that the interface Gs will give the SGSN not only the identity of the user UEs in connected mode with the MSC but also the identity of the SRNCs for the corresponding connections. The SGSN then directly transmits the paging message to the SRNC without going through the MSC.

## Claims

1. Mobile radio telecommunications system comprising a core network operative to communicate by means of a UTRAN network with a plurality of user equipments (30), said core network comprising a mobile switching centre (10) and at least one serving GPRS support node (11), each user equipment being able to work selectively in two operating modes, firstly a connected mode in which the resources of the system are allocated to setting up a connection between the user equipment (30) and said mobile switching centre (10) and/or at least one serving GPRS support node (11), and secondly an idle mode,

in which an interface (Gs) is provided by which in use said mobile switching centre (10) and said at least one serving GPRS support node (11) communicate said interface being designed to give said at least one serving GPRS support node (11) the identity of the user equipments in connected mode with said mobile switching centre (10), said interface (Gs) being furthermore designed to give said at least one serving GPRS support node (11) the identity of serving radio network controllers (20, 21, 22, 23) with which said mobile switching centre (10) is linked to communicate with said user equipments in connected mode, and in that, to page one of the user equipments in connected mode with said mobile switching centre (10), said at least one serving GPRS support node (11) is operative in use to directly communicates with the serving radio network controller concerned without going through said mobile switching centre (10)

**characterised in that** said mobile switching centre (10) periodically sends to the serving GPRS support node (11) the identities of the user equipments in connected mode.

2. System according to claim 1 **characterized in that** said interface (Gs) is designed to give the identity of the user equipments in connected mode with said mobile switching centre (10) upon a request from

said at least one serving GPRS support node (11).

3. System according to claim 2, **characterised in that** said interface (Gs) is designed to give the identities of the serving radio network controllers with which said mobile switching centre is linked to communicate with said user equipment in connected mode upon the request from said at least one serving GPRS support node (11).
4. A system according to claim 1, 2 or 3, **characterized in that** said interface (Gs) is designed to give the identities of the user equipments in connected mode with said mobile switching centre (10) regularly on the initiative of the mobile switching centre (10).
5. System according to claim 4, **characterised in that** said interface (Gs) is designed to give the identities of the serving radio controllers with which said mobile switching centre is linked to communicate with said user equipments in connected mode regularly on the initiative of the mobile switching centre.

#### Patentansprüche

1. Mobilfunksystem mit einem Kernnetz zum Kommunizieren mittels eines UTRAN-Netzes mit einer Mehrzahl von Benutzereinrichtungen (30), wobei das Kernnetz eine Mobilvermittlungsstelle (10) und mindestens einen Dienstenetzknoten (Serving GPRS Support Node) (11) umfaßt, wobei jede Benutzereinrichtung selektiv in zwei Betriebsmodi arbeiten kann, erstens einem verbundenen Modus, bei dem die Ressourcen des Systems dem Aufbau einer Verbindung zwischen der Benutzereinrichtung (30) und der Mobilvermittlungsstelle (10) und/oder mindestens einem Dienstenetzknoten (11) zugeordnet sind, und zweitens einem Ruhemodus, bei dem eine Schnittstelle (Gs) bereitgestellt wird, durch die im Gebrauch die Mobilvermittlungsstelle (10) und der mindestens eine Dienstenetzknoten (11) kommunizieren, wobei diese Schnittstelle dafür ausgelegt ist, dem mindestens einen Dienstenetzknoten (11) die Identität der Benutzereinrichtungen im verbundenen Modus mit der Mobilvermittlungsstelle (10) zu geben, wobei diese Schnittstelle (Gs) weiterhin dafür ausgelegt ist, dem mindestens einen Dienstenetzknoten (11) die Identität von bedienenden Funknetzsteuerungen (20, 21, 22, 23) zu geben, mit denen die Mobilvermittlungsstelle (10) verknüpft ist, um mit den Benutzereinrichtungen im verbundenen Modus zu kommunizieren, und daß zum Rufen einer der Benutzereinrichtungen im verbundenen Modus mit der Mobilvermittlungsstelle (10) der mindestens eine Dienstenetzknoten (11) im Gebrauch direkt mit der betroffenen bedienenden

Funknetzsteuerung kommunizieren kann, ohne über die Mobilvermittlungsstelle (10) zu gehen, **dadurch gekennzeichnet, daß** diese Mobilvermittlungsstelle (10) dem Dienstenetzknoten (11) periodisch die Identitäten der Benutzereinrichtungen im verbundenen Modus sendet.

2. System nach Anspruch 1, **dadurch gekennzeichnet, daß** die Schnittstelle (Gs) dafür ausgelegt ist, die Identität der Benutzereinrichtungen im verbundenen Modus mit der Mobilvermittlungsstelle (10) bei Anforderung von mindestens einem Dienstenetzknoten (11) zu geben.
3. System nach Anspruch 2, **dadurch gekennzeichnet, daß** die Schnittstelle (Gs) dafür ausgelegt ist, die Identitäten der bedienenden Funknetzsteuerungen, mit denen die Mobilvermittlungsstelle verknüpft ist, um mit der Benutzereinrichtung im verbundenen Modus zu kommunizieren, bei Anforderung von dem mindestens einen Dienstenetzknoten (11) zu geben.
4. System nach Anspruch 1, 2 oder 3, **dadurch gekennzeichnet, daß** die Schnittstelle (Gs) dafür ausgelegt ist, die Identitäten der Benutzereinrichtungen im verbundenen Modus mit der Mobilvermittlungsstelle (10) regelmäßig auf Initiative der Mobilvermittlungsstelle (10) zu geben.
5. System nach Anspruch 4, **dadurch gekennzeichnet, daß** die Schnittstelle (Gs) dafür ausgelegt ist, die Identitäten der bedienenden Funknetzsteuerungen, mit denen die Mobilvermittlungsstelle verknüpft ist, um mit den Benutzereinrichtungen im verbundenen Modus zu kommunizieren, regelmäßig auf Initiative der Mobilvermittlungsstelle zu geben.

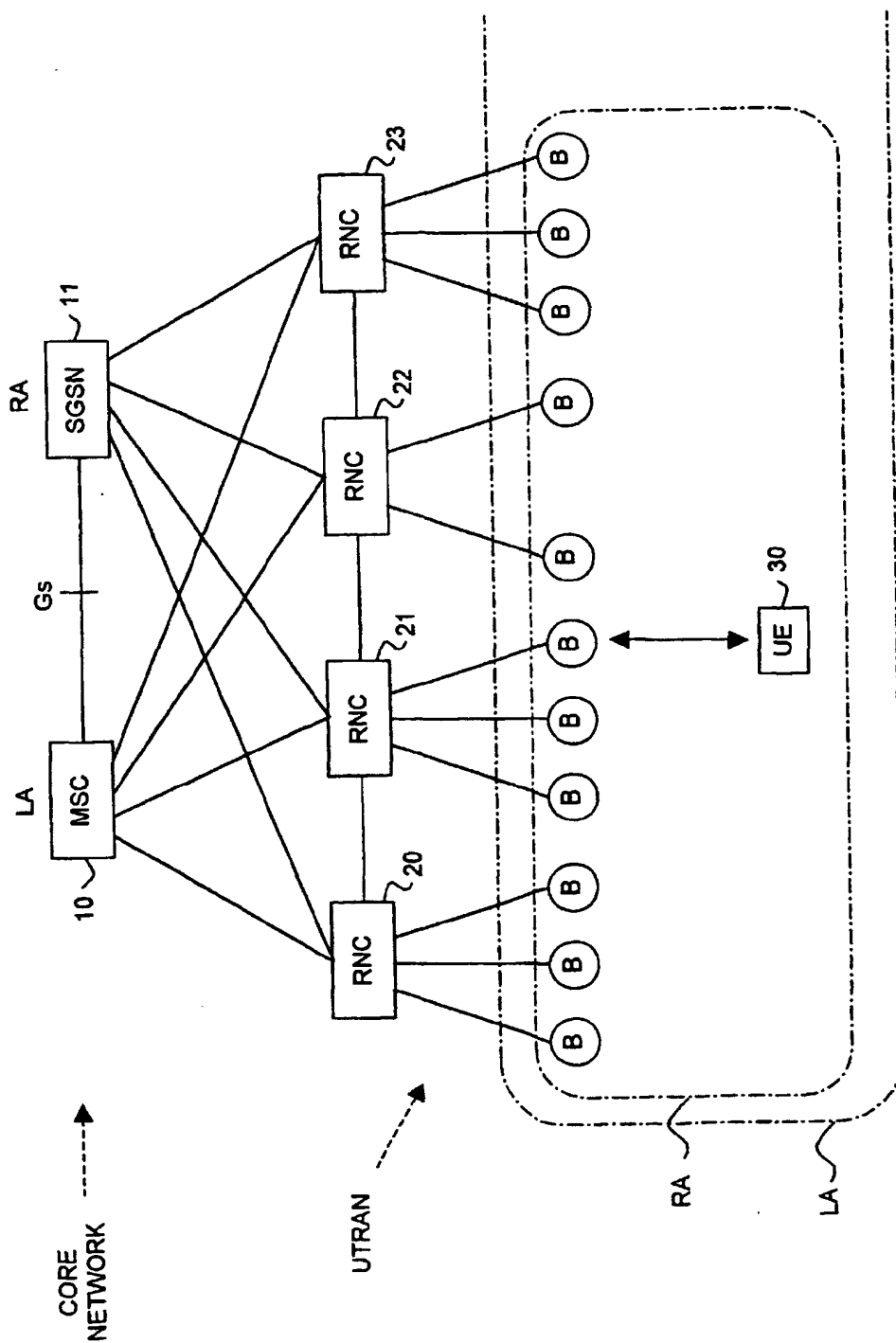
#### Revendications

1. Système de télécommunication radio mobile comprenant un réseau d'infrastructure opérationnel pour communiquer au moyen d'un réseau UTRAN avec une pluralité d'équipements d'utilisateur (30), ledit réseau d'infrastructure comprenant un centre de commutation mobile (10) et au moins un noeud de support GPRS de service (11), chaque équipement d'utilisateur étant en mesure de fonctionner sélectivement dans deux modes de fonctionnement, premièrement un mode connecté dans lequel les ressources du système sont allouées pour établir une connexion entre l'équipement d'utilisateur (30) et ledit centre de commutation mobile (10) et/ou au moins un noeud de support GPRS de service (11), et deuxièmement un mode de veille, dans lequel une interface (Gs) est fournie par l'utilisation de laquelle ledit centre de commutation mo-

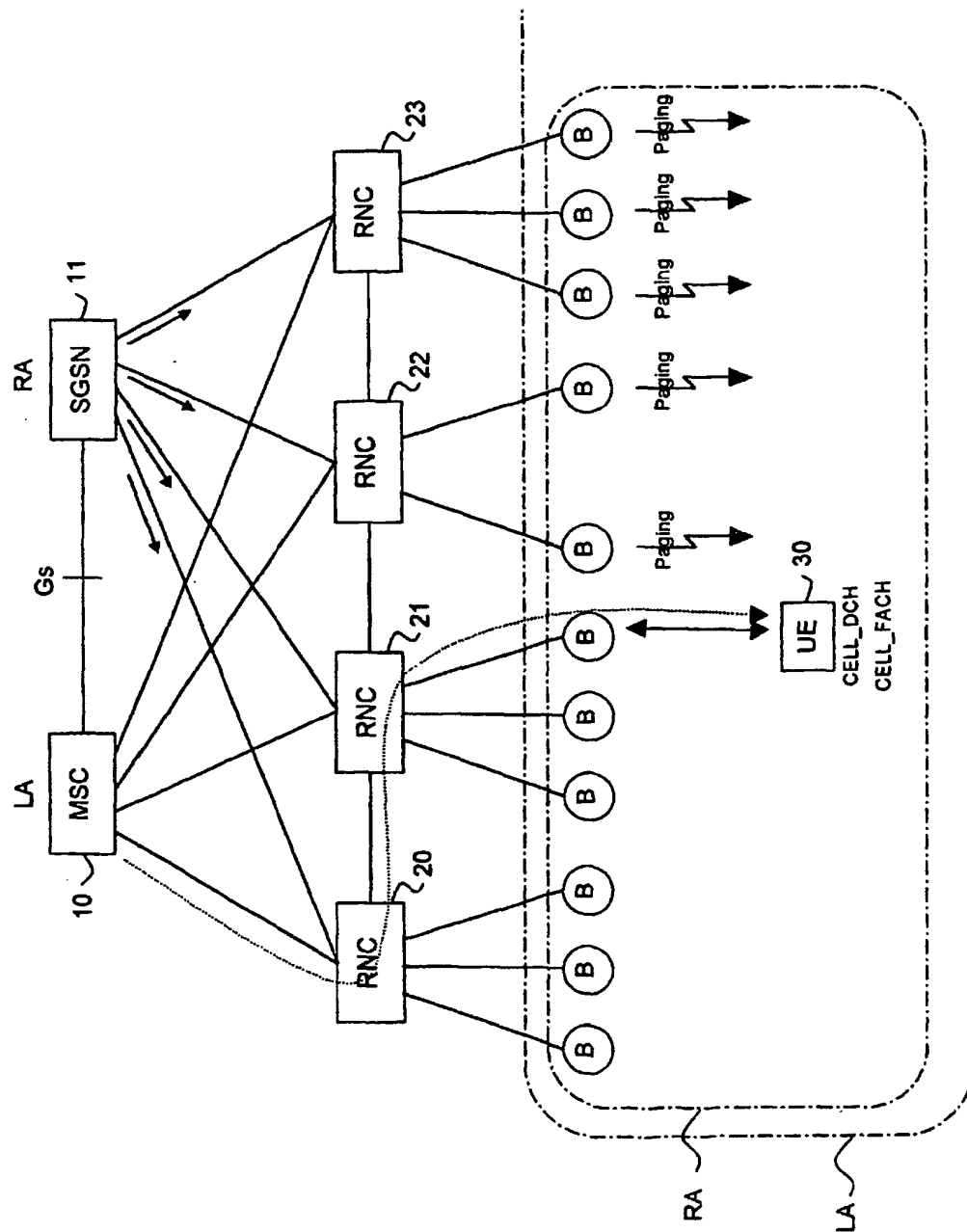
bile (10) et ledit au moins un noeud de support GPRS de service (11) communiquent ladite interface étant conçue pour donner audit au moins un noeud de support GPRS de service (11) l'identité des équipements d'utilisateur en mode connecté 5 avec ledit centre de commutation mobile (10), ladite interface (Gs) étant en outre conçue pour donner audit au moins un noeud de support GPRS de service (11) l'identité des contrôleurs de réseau radio de service (20, 21, 22, 23) avec lesquels ledit centre 10 de commutation mobile (10) est lié pour communiquer avec lesdits équipements d'utilisateur en mode connecté, et en ce que, pour appeler un des équipements d'utilisateur en mode connecté avec ledit centre de commutation mobile (10), ledit au 15 moins un noeud de support GPRS de service (11) est opérationnel dans l'utilisation pour communiquer directement avec le contrôleur de réseau radio de service concerné sans passer par ledit centre de commutation mobile (10) 20

**caractérisé en ce que** ledit centre de commutation mobile (10) envoie périodiquement au noeud de support GPRS de service (11) les identités des équipements d'utilisateur en mode connecté. 25

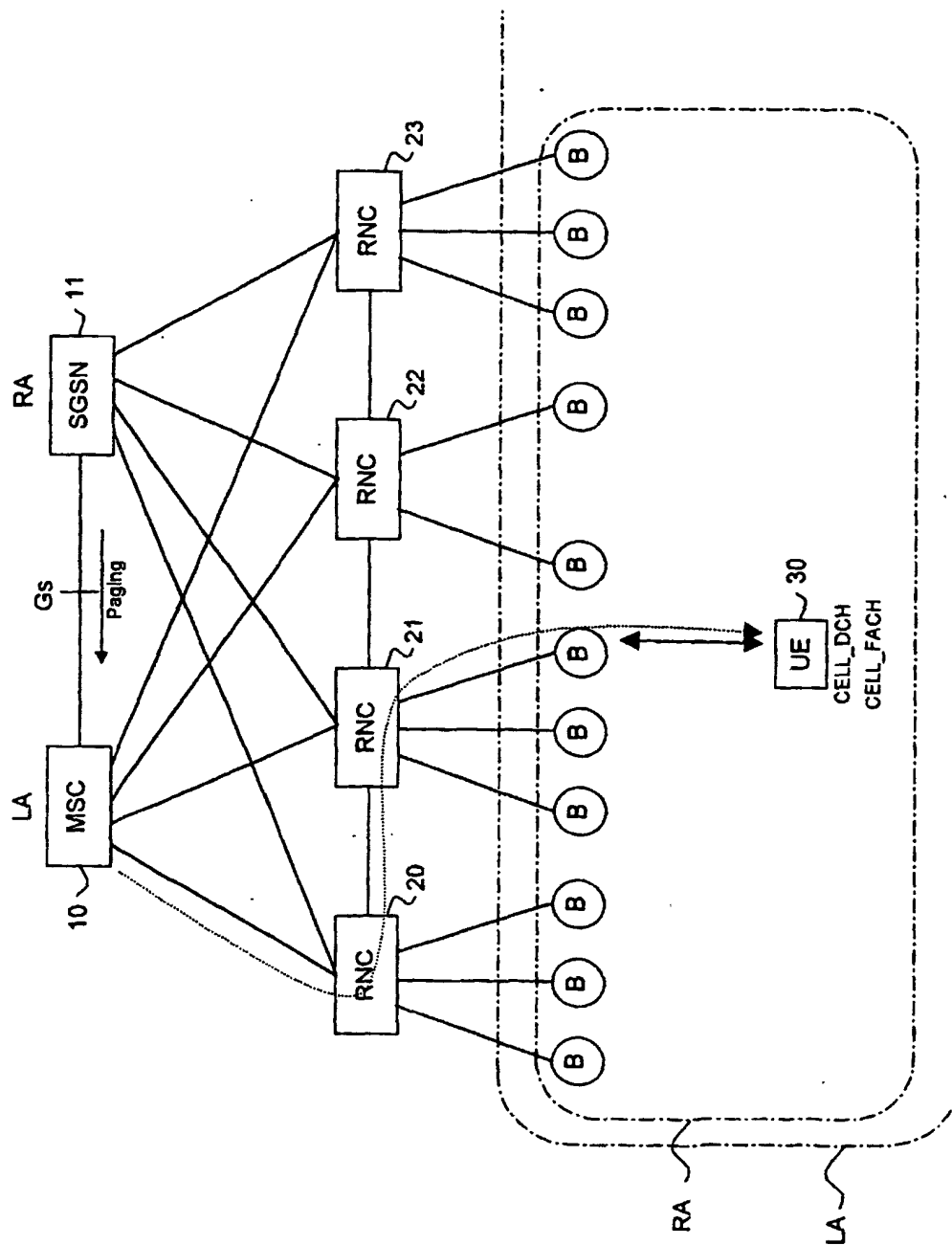
2. Système selon la revendication 1 **caractérisé en ce que** ladite interface (Gs) est conçue pour donner l'identité des équipements d'utilisateur en mode connecté avec ledit centre de commutation mobile (10) dès une requête dudit au moins un noeud de support GPRS de service (11). 30
3. Système selon la revendication 2, **caractérisé en ce que** ladite interface (Gs) est conçue pour donner les identités des contrôleurs de réseau radio de service avec lesquels ledit centre de commutation mobile est lié pour communiquer avec ledit équipement d'utilisateur en mode connecté dès la requête dudit au moins un noeud de support GPRS de service (11). 35 40
4. Système selon la revendication 1, 2 ou 3, **caractérisé en ce que** ladite interface (Gs) est conçue pour donner les identités des équipements d'utilisateur en mode connecté avec ledit centre de commutation mobile (10) régulièrement sur l'initiative du centre de commutation mobile (10). 45
5. Système selon la revendication 4, **caractérisé en ce que** ladite interface (Gs) est conçue pour donner les identités des contrôleurs radio de service avec lesquels ledit centre de commutation mobile est lié pour communiquer avec lesdits équipements d'utilisateur en mode connecté régulièrement sur l'initiative du centre de commutation mobile. 50 55



**FIG.1**







**FIG.3**